Geophysical Research Abstracts
Vol. 20, EGU2018-8238, 2018
EGU General Assembly 2018

Automated calibration for 3D morphodynamic numerical models

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In order to describe the complexity of flow characteristics and sediment transport mechanisms in river bends and meandering channels, the use of three-dimensional numerical models is essential. Nevertheless, these models are highly parameterized, especially when taking sediment transport into account. The model calibration process can thus be laborious and highly time-consuming. Using model-independent calibration tools may be beneficial as they can decrease the manual effort in calibration processes by reducing the subjectivity of the user, and can help to decrease errors caused by inaccurate assumptions and combinations of involved parameters.

In this study, the morphological bed changes in a U-shaped channel were simulated by the fully three-dimensional numerical model SSIIM 2 (Sediment Simulation in Intakes with Multiblock option). As an automatic calibration tool the software package PEST (Model-Independent Parameter Estimation and Uncertainty Analysis) was used. Within the model, different sediment transport formulae (e.g. Van Rijn or Mayer-Peter and Mueller) and other sediment related parameters, such as the angle of repose, bed roughness and the active layer thickness were used and varied during the calibration process. One important aspect in PEST is the pre-selection of ranges in which the parameters can be varied by the software during the calibration process. This makes it feasible to take parameters only in a physically plausible range into account.

From the achieved results, it can be concluded that the used numerical model SSIIM 2 along with the PEST automatic calibration tool is capable of simulating the morphological bed changes in meandering channels with about 80 % reduction in calibration time. Comparisons between the simulated bed topography and the experimental data regarding the deposition and scour regions as well as their magnitudes in different sections demonstrate an acceptable degree of accuracy for the automatic calibration process.